

PRELIMINARY DRAINAGE REPORT

San Diego Freeway (I-405) Improvement Project
SR-73 to I-605

Orange and Los Angeles Counties

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1.0 INTRODUCTION

1.1 Project Overview and Location

The California Department of Transportation (Caltrans), in cooperation with the Orange County Transportation Authority (OCTA), proposes to improve the freeway mainline and interchanges on Interstate 405 (I-405) for approximately 16 miles (mi) between 0.2 miles south of Bristol Street and 1.4 miles north of Interstate 605 (I-605) as well as portions of State Route 22 (SR-22), State Route 73 (SR-73), and I-605 to reduce congestion and improve lane continuity through the corridor. The project corridor is primarily located in Orange County with minor improvements in Los Angeles County. Three build alternatives and a No Build Alternative are being considered for this project. The proposed project would relieve congestion and improve operational efficiency on I-405 between SR 73 and I-605.

1.2 Drainage Study Description

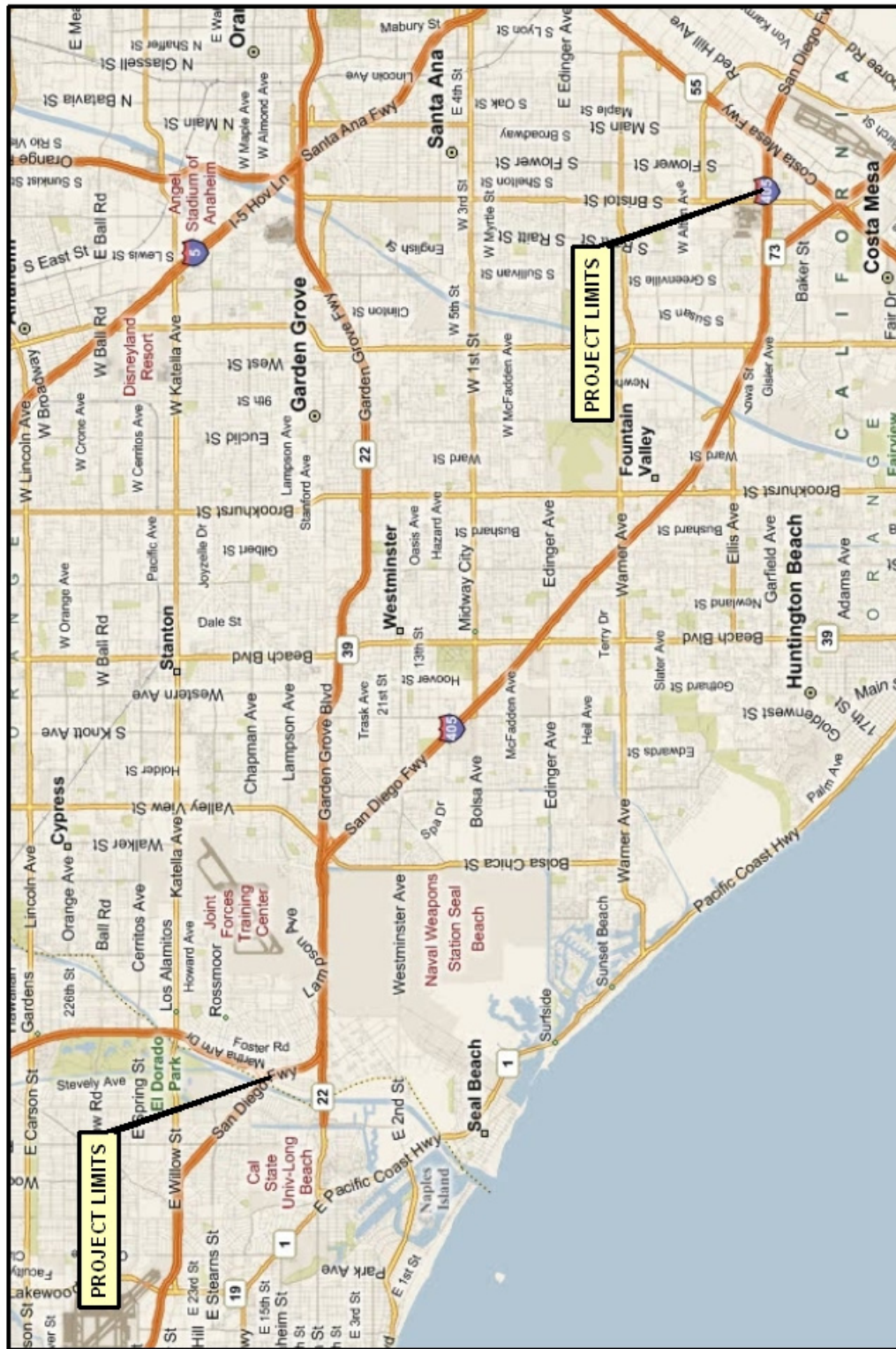
The study will discuss the offsite and onsite drainage tributary to the roadway improvements. Existing inlets, storm drains, major cross drainage, floodplains, and future flood control facilities will be identified. Drainage will be coordinated with several agencies, such as Orange County Flood Control District (OCFCD), Caltrans, and Cities.

Offsite system evaluation will be based on an offsite flow rate provided by the County of Orange, Federal Emergency Management Agency (FEMA), and/or Caltrans. A qualitative assessment will be made for existing cross drainage systems to assess any potential reconstruction to accommodate the freeway widening. Offsite systems also include local street drainage.

Onsite systems consist of areas within the freeway right-of-way (ROW) including travel way, shoulders, medians, ramps and embankment areas.

Because this project is in the planning stages (project approval/environmental document [PA/ED]), this drainage study will be an overview of the existing drainage conditions and will cover existing information available. Drainage issues will be identified; however, no hydrologic and hydraulic calculations will be completed at this time. A detailed offsite and onsite hydrology

I-405 IMPROVEMENT PROJECT SR-73 to I-605



PROJECT LOCATION MAP
Figure 1

and hydraulic analysis will be included in the subsequent plans, specifications, and estimate (PS&E) phase.

Preliminary Hydraulic Reports for major waterways under bridges will be prepared as stand-alone documents. These reports will discuss impacts of the bridge and culvert extensions to the channels and provide the necessary hydraulic calculations.

The project also includes improvements to I-605 and SR 22 freeways. Only re-striping and signing are proposed therefore, no roadway or drainage construction is proposed. There will be some work on SR-73 including minor mainline widening (SB side) and partial ramp reconstruction of the Bear St. SB off-ramp.

1.3 Project Location

Figure 1 shows the project location map. I-405 consists of 8 to 12 mixed-flow general purpose (GP) lanes, two high-occupancy vehicle (HOV) lanes, auxiliary lanes along selected portions of the route, and 21 arterial crossings (OCTA 2009).

1.4 Project Alternatives

1.4.1 No Build Alternative

Except as discussed in the subsequent paragraph, the No Build Alternative would maintain the existing configuration of the I-405 corridor with no additional lanes or interchange improvements to be provided. The existing configuration would not accommodate the future traffic demand, and the nonstandard features would not be corrected. Congestion along the corridor would not be alleviated, and the situation would deteriorate with time. This alternative is inconsistent with the Caltrans goal of providing an efficient and effective interregional mobility system. Because there are no improvements anticipated within the project limits, there are no construction or ROW costs associated with this alternative.

The future configuration under the No Build Alternative would assume completion of the West County Connector (WCC) Project, which is currently under construction and anticipated to be completed by 2014. The WCC Project would add two HOV lanes in the median of I-405

between SR-22 and I-605, along with HOV direct connectors at the I-405/SR-22 and I-405/I-605 interchanges. Nine structures would be constructed as part of the WCC Project including:

- Bolsa Chica Road OC (replace), 55-1102, PM 0.92
- S405-E22 Connector (replace), 55-1101F, PM 20.75
- 22-405 HOV Direct Connector (new), 55-1103E, PM 20.66
- Seal Beach Boulevard OC (replace), 55-1099, PM 22.64
- N405-W22 Connector Separation (replace), 55-1100G, PM 23.27
- 405-605 HOV Direct Connector (new), 55-1098E, PM 24.02
- E22-N405 Connector UC (Lengthen), 55-0415, PM R0.16
- E22-N405/405 Separation Structure (replace), 55-1096G, PM R0.39
- E22-N605/405 Separation (replace), 55-1097G, PM R0.39

1.4.2 Build Alternative 1: Add One General Purpose Lane in Each Direction

Alternative 1 proposes to add one general purpose lane in each direction of I-405 from Euclid Street to I-605.

Proposed Engineering Features

Proposed engineering features in Alternative 1 are summarized as follows:

- Mainline features include:
 - Addition of one general purpose lane in each direction
 - New NB auxiliary lane at the approach to the Euclid Street NB off-ramp
 - New NB auxiliary lane between the Seal Beach Boulevard NB on-ramp and the N405-W22 Connector
 - Extension of the SB auxiliary lane between the Euclid Street SB on-ramp and the Harbor Boulevard SB off-ramp
 - Removal of the SB auxiliary lane between the Beach Boulevard SB on-ramp and the Magnolia Street SB off-ramp
- Interchange features include:
 - Reconstruction of the Euclid Street interchange with addition of a new direct on-ramp from EB Euclid Street to SB I-405

- Reconstruction of the Talbert Avenue SB on-ramp
- Reconfiguration of the Brookhurst Street interchange from cloverleaf to partial cloverleaf by replacing the existing NB loop and direct off-ramps with a single NB off-ramp serving both NB and SB Brookhurst Street and replacing the existing SB loop and direct off-ramps with a single SB off-ramp serving both directions of Brookhurst Street
- Reconfiguration of the Warner Avenue and Magnolia Street interchanges with new braiding of the Warner Avenue NB on-ramp over the Magnolia Street NB off-ramp and new braiding of the Warner Avenue SB loop off-ramp under the Magnolia Street SB loop on-ramp
- Reconstruction of the Edinger Avenue SB on-ramp
- Reconfiguration of the Beach Boulevard interchange by replacing the existing NB loop and direct off-ramps with a single NB off-ramp serving both NB and SB Beach Boulevard and replacing the existing SB loop off-ramp to NB Beach Boulevard and the SB hook off-ramp to Center Avenue with a single SB hook off-ramp to Center Avenue which connects to both directions of Beach Boulevard
- Reconstruction of the Bolsa Avenue interchange
- Reconstruction of the Goldenwest Street interchange
- Reconfiguration of the Westminster Boulevard interchange by replacing the existing NB direct off-ramp to Willow Lane and the NB loop off-ramp to WB Westminster Boulevard with a single NB loop off-ramp serving both NB and SB Westminster Boulevard
- Reconstruction of the Springdale Street SB off-ramp
- Reconstruction of the Bolsa Chica Road interchange with modification of the SB off-ramp terminus to connect with Bolsa Chica Road via a tee intersection
- Reconstruction of the Seal Beach Boulevard interchange ramps
- Reconstruction of the Old Ranch Parkway NB on-ramp to N405-W22 Connector
- Reconstruction of portions of the S405-E22, W22-N405, N405-W22 and E22-S405 Connectors
- Removal of the existing HOV preferential lane striping from the Euclid Street NB on-ramp, Brookhurst Street NB on-ramp, Magnolia Street NB on-ramp, Beach Boulevard

NB on-ramp, and Westminster Boulevard SB on-ramp to provide additional storage for general purpose ramp lanes

- Additional ramp widening near ramp intersections to accommodate the projected queues and turning movements onto or from the ramps
- Additional through and turn lanes at ramp intersections with local streets
- Structural features include:
 - 8 new structures, 17 structure replacements, and 5 structure widening/modifications
 - 5 flood control channel upgrades and 1 new storm drain bypass system
 - Retaining walls where needed
 - Reconstruction of existing soundwalls impacted by the project and construction of new ones where warranted

1.4.3 Build Alternative 2: Add Two General Purpose Lanes in Each Direction

Alternative 2 proposes to add one general purpose lane in both directions of I-405 from Euclid Street to I-405 and a second general purpose lane northbound from Brookhurst Street to the SR-22/7th Street interchange and southbound from Seal Beach Boulevard to Brookhurst Street.

Proposed Engineering Features

Proposed engineering features in Alternative 2 are summarized as follows:

- Mainline features include:
 - Addition of two general purpose lanes in each direction
 - New NB auxiliary lane at the approach to the Euclid Street NB off-ramp
 - New NB auxiliary lane between the Euclid Street NB on-ramp and the Brookhurst Street NB off-ramp
 - Extension of the SB auxiliary lane between the Euclid Street SB on-ramp and the Harbor Boulevard SB off-ramp
 - Removal of the SB auxiliary lane between the Beach Boulevard SB on-ramp and the Magnolia Street SB off-ramp.
- Interchange features include:

- Reconstruction of the Euclid Street interchange with addition of a new direct on-ramp from EB Euclid Street to SB I-405
- Reconstruction of the Talbert Avenue SB on-ramp
- Reconfiguration of the Brookhurst Street interchange from cloverleaf to partial cloverleaf by replacing the existing NB loop and direct off-ramps with a single NB off-ramp serving both NB and SB Brookhurst Street and replacing the existing SB loop and direct off-ramps with a single SB off-ramp serving both directions of Brookhurst Street
- Reconfiguration of the Warner Avenue and Magnolia Street interchanges with new braiding of the Warner Avenue NB on-ramp over the Magnolia Street NB off-ramp and new braiding of the Warner Avenue SB loop off-ramp under the Magnolia Street SB loop on-ramp
- Reconstruction of the Edinger Avenue SB on-ramp
- Reconfiguration of the Beach Boulevard interchange by replacing the existing NB loop and direct off-ramps with a single NB off-ramp serving both NB and SB Beach Boulevard and replacing the existing SB loop off-ramp to NB Beach Boulevard and the SB hook off-ramp to Center Avenue with a single SB hook off-ramp to Center Avenue which connects to both directions of Beach Boulevard
- Reconstruction of the Bolsa Avenue interchange
- Reconstruction of the Goldenwest Street interchange
- Reconfiguration of the Westminster Boulevard interchange by replacing the existing NB direct off-ramp to Willow Lane and the NB loop off-ramp to WB Westminster Boulevard with a single NB loop off-ramp serving both NB and SB Westminster Boulevard
- Reconstruction of the Springdale Street SB off-ramp
- Reconstruction of the Bolsa Chica Road interchange with modification of the SB off-ramp terminus to connect with Bolsa Chica Road via a tee intersection
- Reconstruction of the Seal Beach Boulevard interchange ramps
- Reconstruction of the Old Ranch Parkway NB on-ramp to N405-W22 Connector
- Reconstruction of portions of the S405-E22, W22-N405, N405-W22 and E22-S405 Connectors

- Removal of the existing HOV preferential lane striping from the Euclid Street NB on-ramp, Brookhurst Street NB on-ramp, Magnolia Street NB on-ramp, Beach Boulevard NB on-ramp, and Westminster Boulevard SB on-ramp to provide additional storage for general purpose ramp lanes
- Additional ramp widening near ramp intersections to accommodate the projected queues and turning movements onto or from the ramps
- Additional through and turn lanes at ramp intersections with local streets.
- Structural features include:
 - 8 new structures, 17 structure replacements, and 5 structure widening/modification
 - 5 flood control channel upgrades and 1 new storm drain bypass system
 - Retaining walls where needed
 - Reconstruction of existing soundwalls impacted by the project and construction of new ones where warranted

1.4.4 Build Alternative 3: Add One General Purpose Lane Plus Express Lane in Each Direction

Alternative 3 is the only alternative being considered with a toll component that may utilize future potential public-private partnership and design-build authority to construct. Alternative 3 would add one general purpose lane in each direction along I-405 from Euclid Street to I-605 and add an additional median lane in each direction from SR-73 to SR-22 East to operate together with existing HOV lanes as an Express Facility in which eligible HOVs would travel free and other vehicles would pay a toll. The Express Facility would consist of 4 lanes, 2 in each direction from SR-73 to I-605. The Express Facility component of Alternative 3 would provide a reliable, predictable commute for the I-405 express lane users and optimize vehicle throughput on the I-405 corridor.

Proposed Engineering Features

Proposed engineering features in Alternative 3 are summarized as follows:

- Mainline features include:
 - Addition of one general purpose lane in each direction

- Provision of tolled lanes which would serve qualified HOVs free of charge from SR-73 to I-605
- New NB auxiliary lane at the approach to the Euclid Street NB off-ramp
- New NB auxiliary lane between the Seal Beach Boulevard NB on-ramp and the N405-W22 Connector
- Extension of the SB auxiliary lane between the Euclid Street SB on-ramp and the Harbor Boulevard SB off-ramp
- Removal of the SB auxiliary lane between the Beach Boulevard SB on-ramp and the Magnolia Street SB off-ramp
- Interchange features include:
 - A new direct connector between the proposed I-405 express lanes and SR-73
 - Reconstruction of the S405-S73 Connector and partial reconstruction of the N73-N405 Connector
 - Partial reconstruction of the NB I-405/Fairview Road C-D road system
 - Reconstruction of the South Coast Drive NB off-ramp
 - Reconstruction of the Fairview Road interchange
 - Reconstruction of the Susan Street NB off-ramp
 - Partial reconstruction of the Harbor Boulevard interchange
 - Reconstruction of the Hyland Ave NB on-ramp
 - Reconstruction of the Euclid Street interchange with addition of a new direct on-ramp from EB Euclid Street to SB I-405
 - Reconstruction of the Talbert Avenue SB on-ramp
 - Reconfiguration of the Brookhurst Street interchange from cloverleaf to partial cloverleaf by replacing the existing NB loop and direct off-ramps with a single NB off-ramp serving both NB and SB Brookhurst Street and replacing the existing SB loop and direct off-ramps with a single SB off-ramp serving both directions of Brookhurst Street
 - Reconfiguration of the Warner Avenue and Magnolia Street interchanges with new braiding of the Warner Avenue NB on-ramp over the Magnolia Street NB off-ramp and new braiding of the Warner Avenue SB loop off-ramp under the Magnolia Street SB loop on-ramp

- Reconstruction of the Edinger Avenue SB on-ramp
- Reconfiguration of the Beach Boulevard interchange by replacing the existing NB loop and direct off-ramps with a single NB off-ramp serving both NB and SB Beach Boulevard and replacing the existing SB loop off-ramp to NB Beach Boulevard and the SB hook off-ramp to Center Avenue with a single SB hook off-ramp to Center Avenue which connects to both directions of Beach Boulevard
- Reconstruction of the Bolsa Avenue interchange
- Reconstruction of the Goldenwest Street interchange
- Reconfiguration of the Westminster Boulevard interchange by replacing the existing NB direct off-ramp to Willow Lane and the NB loop off-ramp to WB Westminster Boulevard with a single NB loop off-ramp serving both NB and SB Westminster Boulevard
- Reconstruction of the Springdale Street SB off-ramp
- Reconstruction of the Bolsa Chica Road interchange with modification of the SB off-ramp terminus to connect with Bolsa Chica Road via a tee intersection
- Reconstruction of the Seal Beach Boulevard interchange ramps
- Reconstruction of the Old Ranch Parkway NB on-ramp to N405-W22 Connector
- Reconstruction of portions of the S405-E22, W22-N405, N405-W22 and E22-S405 Connectors
- Removal of the existing HOV preferential lane striping from the Euclid Street NB on-ramp, Brookhurst Street NB on-ramp, Magnolia Street NB on-ramp, Beach Boulevard NB on-ramp, and Westminster Boulevard SB on-ramp to provide additional storage for general purpose ramp lanes
- Additional ramp widening near ramp intersections to accommodate the projected queues and turning movements onto or from the ramps
- Additional through and turn lanes at ramp intersections with local streets.
- Structural features include:
 - 10 new structures, 18 structure replacements, and 6 structure widening/modification
 - 7 flood control channel upgrades and 1 new storm drain bypass system
 - Retaining walls where needed
 - Reconstruction of existing soundwalls impacted by the project and construction of new

ones where warranted

1.5 Hydrologic Setting

Climate

The climate of the project area is classified as Mediterranean, which is characterized by warm, dry summers and mild, wet winters. Coastal areas have a moderate climate with frequent fog in the summer. Most of the precipitation comes as rain during the winter months. The major contributions to the climate are the Eastern Pacific High and the Mediterranean effects of the Pacific Ocean. The mean high winter temperature is 65 degrees Fahrenheit (°F), and the mean high summer temperature is 77 °F. Orange County experiences 328 days of sunshine per year and an average daytime temperature of 73 °F.

Rainfall

The annual average rainfall within this project area is approximately 13 inches. (<http://ocwatersheds.com/Documents/Precipitation.pdf>)

Topography

The topography is relatively flat and slopes gradually in the southwesterly direction, with gentle slopes averaging 1 percent to 3 percent.

Soil Data

According to the Orange County Hydrology Manual (1986), soils within the project limits are identified as Hydrologic Soils Groups A, B, and C.

Vegetation

The vegetation varies throughout the project, but it consists of mostly urban landscaping, such as grass, trees, and shrubs. There are areas of unmaintained vegetation throughout the project area that consist of native plants.

Land Use

The land use is generally a fully urbanized area. The drainage tributary consists of dense residential areas, and commercial and industrial developments.

2.0 EXISTING DRAINAGE SYSTEMS

This section describes the existing drainage conditions identified from as-built information, Caltrans, OCFCD, U.S. Geological Survey (USGS) Maps, and FEMA Flood Insurance Rate Maps (FIRM). There are 18 major water courses (as listed in Table 2-3) that cross the existing I-405.

For the most part, offsite drainage is storm runoff generated outside of the freeway ROW but tributary to the project site. Onsite drainage is storm runoff generated within the ROW limits of the project; however, once collected, it will discharge to a major offsite facility.

2.1 As-Built Information

As-built plan information was collected for onsite and offsite systems and incorporated into the Existing Drainage Plans. Proposed drainage improvements for SR-22/West County Connection, Phase I (contract number 12-071614) and the future SR-22/West County Connectors Phase II (12-071624 & 12-071634), were also included in the Existing Drainage Plans. Tables 2-1 and 2-2 list the onsite and offsite as-built information utilized for this report, respectively.

TABLE 2-1
Pertinent Caltrans As-Built Plans (Onsite)

Agency	Contract Number	Title
Caltrans	07-031634	Plans for Construction on State Highway in Orange County between Harbor Boulevard in Costa Mesa and 0.2-mile Southwest of Brookhurst Street in Fountain Valley.
Caltrans	07-019654	Project Plans for Construction on State Highway in Orange County from Route 73 in Costa Mesa to the Los Angeles County Line in Seal Beach.
Caltrans	07-031524	Project Plans for Construction on State Highway in Orange County, Route 73/405 Separation.
Caltrans	07-031724	Project Plans for Construction on State Highway in Orange County in and near Westminster and Huntington Beach between Newland Street and 0.6-mile East of Bolsa Chica Road.

TABLE 2-1
Pertinent Caltrans As-Built Plans (Onsite)

Agency	Contract Number	Title
Caltrans	07-031644	Project Plans for Construction on State Highway in Orange County between 0.2-mile Southwest of Brookhurst Street in Fountain Valley and Beach Boulevard in Westminster.
Caltrans	07-033914	Project Plans for Construction on State Highway in Orange and Los Angeles Counties in and near Los Alamitos and Long Beach between San Diego Freeway and 0.3-mile North of Katella Avenue.
Caltrans	07-394904	Project Plans for Construction on State Highway in Huntington Beach at Beach Boulevard-Center Drive.
Caltrans	12-0A7614	Project Plans for Construction on State Highway in Orange in Huntington Beach and Westminster on Route 405 from 0.02-km Northwest of Newland Street overcrossing to 0.14-km Northwest of Edinger Avenue overcrossing.
Caltrans	12-0J1904	Project Plans for Construction on State Highway in Orange County in Westminster at Bolsa Avenue Off-Ramp.
Caltrans	12-0G6904	Project Plans for Construction on State Highway in Seal Beach from 0.2-km North of Route 22/405 Separation to 7 th Street overcrossing.
Caltrans	12-071614	Project Plans for Construction on State Highway SR-22 HOV Widening
Caltrans	12-071624	Project Plans for Construction on State Highway I-405/SR-22 HOV Connector
Caltrans	12-071634	Project Plans for Construction on State Highway I-405/I-605 HOV Connector Project

TABLE 2-2
Pertinent As-Built Plans (Offsite)

Agency	Drawing Number	Title
Orange County Environmental Management Agency	C03-101-20	Plans for Construction of Anaheim-Barber City channel Facility No. C03 from D/S of San Diego Fwy. (405) to U/S of San Diego Fwy. (405).
Orange County Environmental Management Agency	C03-101-22	Plans for Construction of Anaheim-Barber City Channel Facility No. C03 from 50' D/S of San Diego Fwy. to 200' U/S of Sioux Road.

TABLE 2-2
Pertinent As-Built Plans (Offsite)

Agency	Drawing Number	Title
OCFCD	C03-504-3-A	Plans for Construction of Anaheim-Barber City Channel Facility No. C03.
OCFCD	C02-101-2A	Plans for the Construction of Bolsa Chica Channel from Tidelands to Cerritos Avenue.
Orange County Public Facilities and Resources Department	C02-101-7R	Plans for Construction of Bolsa Chica Channel, Facilities No. C02 from I-405/22 Interchange to Belgrave Avenue.
Orange County Environmental Management Agency	C06-101-7A	Plans for Construction of that portion of Ocean View Channel, Facility No. C06 from Magnolia Street to Bushard Street.
Orange County Environmental Management Agency	C04-101-15A	Plans for Construction of that portion of Westminster Channel, Facility No. C04 from San Diego Fwy. to Chestnut Street.
Orange County Environmental Management Agency	C04-101-16A	Plans for Construction of Westminster Channel, Facility No. C04 from D/S of San Diego Fwy. (405) to U/S of San Diego Fwy. (405).
Orange County Environmental Management Agency	C04-101-17-R	Plans for Construction of Westminster Channel, Facility No. C04 from D/S Goldenwest Street to U/S San Diego Fwy. (I-405).
Orange County Environmental Management Agency	C05-101-5	Plans for Construction of East Garden Grove-Wintersburg Channel, Facility No. C05 from D/S of San Diego Fwy. (405) to U/S San Diego Fwy. (405).
OCFCD	C04-504-4A	Plans for Construction of Westminster Channel, Facility No. C04.
OCFCD	D03-504-1	Plans for Construction of Greenville-Banning Channel, Facility No. D03.
Caltrans	12-071634	Project Plans for Construction on State Highway I-405/I-605 HOV Connector Project Bixby Channel Improvement (Anticipated Completion Date – 2014)

2.2 Existing Drainage System

The existing offsite flow pattern generally is directed to the Pacific Ocean. Major washes and rivers are conveyed under the freeway by culverts or bridges. Sheet flow directed towards the freeway is collected by parallel channels.

The project corridor falls mainly within the Santa Ana River (SAR) Watershed. The SAR Watershed and Subwatersheds shown in Appendix A have been delineated by the Santa Ana Water Project Authority. The exhibit shows large offsite tributary areas that must be examined for this project. As mentioned earlier, these offsite systems are already conveyed under the freeway; however, it is highly recommended that coordination with all stakeholders be maintained throughout the duration of the project. Ongoing and future flood control projects may affect these tributary systems and need to be considered.

The northern tip of the project falls within the San Gabriel River Watershed. The watershed delineation is shown in Appendix A.

2.2.1 Onsite

The onsite drainage system consists of inlets, ditches, and storm drain systems to capture and convey storm runoff away from the roadway. Roadway embankment runoff is typically collected by onsite ditches or channels. Other onsite facilities include down drains and median inlets. Ultimately, onsite flows drain to a larger flood control facility.

2.2.2 Offsite

Table 2-3 lists existing major offsite facilities along the project corridor. These facilities are owned and maintained by OCFCD. The U.S. Army Corps of Engineers (USACE) has jurisdiction over the SAR, with OCFCD as the local sponsor. OCFCD is performing a deficiency study for their facilities based on approximate methods. Coordination should be made during the final design phase.

The locations of crossings correspond to the roadway stationing shown on Drainage Maps D-1a through D-6a, D-1 through D-30 in Attachment 1. Peak 100-year flow rates and the type of existing facility for each channel or storm drain were obtained from OCFCD staff.

TABLE 2-3
Major Flood Control Crossings and Peak Flows

Channel Name	Approximate Freeway Station	Q_{100 year} (cfs)**	Type of Existing Facility
Delhi Storm Drain	Sta 496+00	Unknown ⁺	Triple 15'x15' RCB
Gisler Storm Channel*	Sta 559+00	Unknown ⁺	Varies - 72" RCP, 84" RCP, 10'x10' RCB, 16'x10' RCB, and unknown channel geometry
Mesa Verde Storm Drain	Sta 606+50	Unknown ⁺	8'x5' RCB
Greenville Banning Channel (D03)	Sta 623+88	3,450	Triple 12'x12' RCB
Hyland Avenue Storm Drain	Sta 628+59	370	6'x6' RCB
Santa Ana River	Sta 657+50	47,000	Rectangular concrete-lined with vertical side walls and a central low-flow channel W=240', H=23'
Fountain Valley Channel (D06)	Sta 681+74	172	Double 10'x7' RCB
Ocean View Channel (C06)	Sta 792+00	1,930	Double 12'x9.5' RCB
East Garden Grove Wintersburg Channel (C05)	Sta 840+00	5,910	Triple 10'X 10' RCB 77" X 121" Elliptical RCP
Newland Storm Channel	Sta 840+00	1,080 ⁺⁺	77" x 121" Elliptical RCP
Edinger Storm Channel* (C05S05)	Sta 841+75	380	Concrete Mod Trapezoidal Channel B=4', H=7' Z=1 63" RCP under I-405
Westminster Channel* (C04)	Sta 944+00	4,190	Double 12' X 9.25' RCB

TABLE 2-3
Major Flood Control Crossings and Peak Flows

Channel Name	Approximate Freeway Station	Q _{100 year} (cfs)**	Type of Existing Facility
Anaheim Barber Channel (C03)	Sta 1027+83	6,260	Quad 10'x9' RCB
Milan Storm Drain	Sta 1066+00 - Sta 1084+60	Unknown ⁺	4' X 4' RCB Concrete Trapezoidal Channel, B=2', H=varies, Z=1.5'
Bolsa Chica Channel (C02)	Sta 1099+00	4,150	Triple 12'x10' RCB
Federal Storm Channel	Sta 1173+50	340 [#]	Double 8'x5' RCB
Bixby Storm Channel*	Sta 1221+00	203	Concrete Trapezoidal Channel, B=3', H=3.62' to 4.57', Z=1 WCC Project will improve the channel to B=12', H=4.6' to 6.5' rectangular channel and 9'X6' RCB
Montecito Storm Channel	Sta 1244+50	410	Double 8'X8' RCB

* Runs parallel to I-405 freeway

**Source of information is from OCFCD and Hydrology Reports

+ No data available

++1,080 cubic feet per second (cfs) Estimated Peak 100-year flow and 550 cfs Channel Capacity

With retarding (OCFCD)

RCB – reinforced concrete box; RCP – reinforced concrete pipe

In addition to the above facilities, there are several minor culvert and storm drain crossings. These culverts would have to be extended to accommodate the freeway widening. These facilities are shown on Drainage Maps D-1a through D6a, D-1 through D-30.

The offsite major drainage crossings are described in detail below.

DELHI STORM DRAIN – The Delhi Storm Drain conveys offsite stormwater runoff across I-405 from south to north east of Bristol Street, as shown on Sheet D-1A.

GISLER STORM DRAIN (FACILITY D03S03) – The Gisler Storm Drain runs parallel to I-405 from east to west on the north side of I-405. It confluences with the Greenville-Banning Channel in the southwestern corner of the Coast Drive and Harbor Boulevard intersection in Costa Mesa.

The upstream end of the storm drain is a 72-inch RCP that crosses Bear Street south of I-405. It flows from east to west for approximately 2,700 ft, then changes direction and crosses I-405 going north where it transitions into a 84-inch RCP to a 10-ft by 10-ft RCB to a 16-ft by 10-ft RCB. The RCB transitions to a trapezoidal channel east of Fairview Road. A 10-ft by 9-ft RCB crosses Fairview Road, becoming an 18-ft-wide concrete trapezoidal channel west of Fairview Road. The channel transitions into an 18-ft by 10-ft RCB until it confluences with the Greenville-Banning Channel.

MESA VERDE STORM DRAIN – The Mesa Verde Storm Drain conveys offsite stormwater runoff across I-405 from south to north underneath Harbor Boulevard. The Mesa Verde Storm Drain confluences with the Gisler Storm Drain at the intersection of Harbor Boulevard and Coast Drive. The existing facility under I-405 is an 8-ft by 5-ft RCB, as shown on Sheet D-6a.

GREENVILLE-BANNING CHANNEL (FACILITY NO. D03) – The Greenville-Banning Channel (D03) drains 8,310 acres at its mouth near Pacific Coast Highway and the SAR. The drainage area is located primarily within Costa Mesa and Santa Ana. The size of the existing facility is triple 12-ft by 12-ft RCB, as shown on Sheet D-1.

The peak 100-year discharges for the Greenville-Banning Channel were calculated to be 3,450 cfs crossing I-405 and 4,350 cfs crossing Victoria Street per “Hydrology Report No. D03-4, Greenville-Banning Channel (Facility No. D03),” dated June 1999 by Orange County Environmental Management Agency.

HYLAND AVENUE STORM DRAIN – The storm drain conveys offsite stormwater runoff across I-405 from north to south in Fountain Valley, west of Hyland Avenue. This system is tributary to the Greenville/Banning Channel, and it confluences downstream south of I-405, as shown on Sheet D-1. The size of the existing facility is a 6-ft by 6-ft RCB.

SANTA ANA RIVER – The SAR Watershed is the largest in Orange County. The river begins almost 75 miles away in the San Bernardino Mountains, crossing central Orange County before emptying into the Pacific Ocean. The Orange County portion of the watershed includes portions of Anaheim, Brea, Huntington Beach, Orange, Placentia, Santa Ana, Villa Park, and Yorba Linda. The river serves as the main tributary to the watershed, with Santiago Creek being the largest tributary within Orange County.

The existing facility under I-405 is a concrete-lined rectangular channel with a central low-flow channel. The channel is approximately 240 ft wide with vertical walls approximately 23 ft in height. The bridge over the river is supported by three pier walls on spread footings and concrete piles. The channel is shown on Sheet D-2.

The 100-year discharge is 47,000 cfs per “US Army Corps of Engineers, Design Flood Peak Dischargers, SAR, Future Conditions,, “Santa Ana River Mainstem Phase II General Design.”

FOUNTAIN VALLEY CHANNEL – The channel conveys offsite stormwater runoff across I-405 from the north to south in Fountain Valley. The peak 100-year discharge for the Fountain Valley Channel is 172 cfs. The size of this existing facility is double 10-ft by 7-ft RCB. The channel drains to the Talbert Channel.

OCEAN VIEW CHANNEL (FACILITY NO. C06) – The total drainage area for this facility is approximately 3,380 acres at its discharge point. The channel is located primarily in Fountain Valley, with small portions in Huntington Beach, Santa Ana, and Westminster. The size of the existing facility crossing I-405 is a double 12-ft by 9.5-ft RCB, as shown on Sheet D-8.

Between Ross Lane and Bushard Street, the channel has been improved and consists of various sizes of vertical wall and double RCB channels.

The 100-year discharge crossing I-405 is calculated to be 1,930 cfs for a tributary drainage area of 2,360 acres, per “Hydrology Report No. C06-2, Ocean View Channel, Facility No, C06, Entire Drainage System” dated November 1989 by Environmental Management Agency.

EAST GARDEN GROVE-WINTERSBURG CHANNEL (FACILITY NO. C05) – The total watershed tributary area is approximately 28.1 square miles at its discharge point, the Bolsa Chica Wetlands.

The channel drains portions of the cities of Anaheim, Fountain Valley, Garden Grove, Huntington Beach, Orange, Santa Ana, and Westminster. The main watercourse was a historic overflow path of the Santa River's main stream that flowed through downtown Anaheim prior to the 1918 diversion of the SAR into its present course, leaving the C05 system to serve as a local drainage facility.

Haster Basin (C05S02) and West Street Basin (C05B01), near the headwaters of the C05S01 tributary, are two facilities of deficient capacity that provide some retarding effects downstream.

The peak 100-year discharge is calculated to be 5,910 cfs for a contributing drainage area of 9,264 acres per "Hydrology report for East Garden Grove-Wintersburg Channel (Facility No. C05) Bolsa Chica Bay to Vermont Avenue" dated July 1990 by Environmental Management Agency. According to this hydrology report, both East Garden Grove-Wintersburg Channel (C05) and Ocean View Channel (C06) are deficient for nearly their entire length.

Upstream of Haster Basin, the EGGW Channel consists of concrete-lined open channel and more than 1,000 ft of box culvert extending to Chapman Avenue and continues upstream as an underground facility. Downstream of C05B02, the channel is predominantly a graded earthen channel with some reaches of concrete and rip-rap overlay lining. C05 is levied channel from the ocean outlet to just upstream of I-405.

The size of the existing facility is 77-inch by 121-ft elliptical RCP and triple 10-ft by 10-ft RCB under I-405. Major flood control facilities tributary to this system are the Newland Storm Channel, Edinger Channel, and Ocean View Channel (C06), in addition to numerous onsite drainage laterals that convey flow from I-405.

OCFCD is currently studying the EGGW's complex drainage system under I-405. With several major tributaries, confluences, and undersized systems, a hydraulic physical model was developed to provide the most accurate understanding of the proposed channel improvements.

NEWLAND STORM CHANNEL (FACILITY NO. C05S01) – The channel conveys offsite flows from north to south and generally runs parallel to Newland Street. The riprap-lined trapezoidal channel transitions to a 72-inch RCP prior to draining to the EGGW Storm Channel upstream of I-405. A 77-inch by 121-inch elliptical RCP bypass pipe for the Newland Channel crosses I-405, as shown on Sheet D-11.

The Newland Storm Channel drainage area is approximately 914 acres and is located primarily in Westminster and an unincorporated portion of Orange County. Approximately 9 acres on the northeasternmost part is within Garden Grove, and approximately 1-acre on the southernmost part is within Huntington Beach.

The estimated 100-year discharge is calculated to be 1,080 cfs approximately 150 ft upstream of the EGGW per “Hydrology Report – Newland Storm Channel Facility No. C05S01” by Orange County Resources and Development Management Department dated August 2005.

The channel is currently under capacity. Per the hydrology report, the reach from Edinger Avenue to approximately 150 ft upstream of the EGGW Channel was designed to convey a discharge of 550 cfs.

EDINGER STORM CHANNEL (FACILITY NO. C05S05) – The drainage area for the Edinger Storm Channel is approximately 316 acres located primarily in the City of Westminster. A small portion at the lower end of the drainage area is in Huntington Beach.

The channel outlets at the East Garden Grove-Wintersburg Channel (EGGW) immediately south of I-405. The freeway crossing is a 63-inch RCP located just west of Newland Street. The channel then becomes a concrete-lined trapezoidal channel running parallel to the northbound side of I-405. It transitions to a 63-inch RCP at Edinger Avenue and continues upstream as a concrete-lined trapezoidal channel until it meets the Midway City Drain (C05P06) along Beach Boulevard. The 63-inch RCP underneath Edinger Avenue is under jurisdiction of the Cities of Huntington Beach and Westminster, and the 63-inch RCP under I-405 is under jurisdiction of Caltrans. The channel is shown on Sheets D-11, D-12, and D-13.

OCFCD has recently completed improvement plans to improve the Edinger Storm Channel to provide additional hydraulic capacity. Proposed improvement includes a new 72-inch by 113-inch elliptical RCP under I-405 and a wider rectangular channel upstream. The project limits are from the East Garden Grove Wintersburg Channel to 1,625.5 feet upstream of Edinger Ave. Plans obtained from OCFCD shows the Q_{100} of 380 cfs at the rectangular channel just upstream of the proposed I-405 crossing.

WESTMINSTER CHANNEL (FACILITY NO. C04) – The Westminster Channel (C04) drains approximately 6,960 acres of tributary area and is located in the cities of Garden Grove, Huntington Beach, Santa Ana, and Westminster. The 100-year peak flow rate upstream of the confluence with the Bolsa Chica Channel is calculated to be 9,520 cfs, for a contributing area of 6,960 acres. The peak 100-year discharge at I-405 is estimated to be 4,190 cfs, with a contributing drainage area of 5,360 acres, per “Hydrology Report No.C04-4, Westminster Channel (Facility No. c04) Entire Drainage System Hydrology” dated December 2002 by Orange County Public Facilities and Resources Department.

The channel conveys offsite stormwater runoff across I-405 in a southwesterly direction. The size of the existing facility is a double 12-ft by 9.25-ft RCB that outlets into the vicinity of the Goldenwest Street/I-405 interchange in Westminster, as shown on Sheet D-16.

ANAHEIM-BARBER CHANNEL (FACILITY NO. C03) – The channel is located within the cities of Westminster, Garden Grove, and Stanton. The channel drains approximately 9,560 acres to its outlet at the Bolsa Chica Channel. The size of the existing facility is a quadruple 10-ft by 9-ft RCB, trapezoidal concrete channel downstream and a rectangular channel upstream from the I-405 crossing, as shown on Sheet D-22.

The Anaheim-Barber City Channel is concrete-lined throughout its entire length, except the portion between Edwards Street and Garden Grove Boulevard, which remains unlined.

The 100-year peak discharge is estimated to be 6,260 cfs from the hydrology report titled “Hydrology Report No. C03-4, Anaheim-Barber City Channel Facility No. C03 Entire Drainage System” dated September 1986 by Orange County Resources and Development Management Department.

MILAN STORM DRAIN – The existing facility is a 4-ft by 4-ft RCB crossing I-405, as shown on Sheet D-21 and D-22. The RCB transitions into a trapezoidal channel downstream of I-405 and drains to the Bolsa Chica Channel (C02).

BOLSA CHICA CHANNEL (FACILITY NO. C02) – The drainage area of the channel C02 consists of approximately 5,610 acres and includes portions of the cities of Anaheim, Cypress, Garden Grove, Los Alamitos, Stanton, and unincorporated County territory. The estimated 100-year peak discharge is calculated to be 4,150 cfs per “Hydrology Report No. C02-4A, Bolsa Chica Channel (C02) San Diego Freeway to Cerritos Avenue,” dated January 1997 by Orange County Public Facilities and Resources Department. The existing crossing is a triple 12 ft by 10-ft RCB, as shown on Sheet D-22.

The Bolsa Chica Channel (C02) is a trapezoidal earth-lined channel that varies in size from a 54-ft base width with 2 to 1 slopes at I-405 to a 4-ft base width with 1-1/2 to 1 side slopes at Cerritos Avenue. The Belgrave Channel (C02S05), and the Garden Grove Channel (C02S02) are the two tributary areas to this channel.

FEDERAL STORM CHANNEL – The channel conveys offsite stormwater runoff across I-405. The size of the existing crossing is a double 8-ft by 5-ft RCB that flows from north to south. It transitions to the channel that parallels the freeway along Perimeter Road.

The estimated 100-year peak flow rate is calculated to be 340 cfs per “Hydrology Report for Los Alamitos Channel.” There is an existing retarding basin (Old Ranch Golf Course Retarding Basin) upstream of I-405 that reduces the flow from 960 cfs to 340 cfs. The contributing drainage area is 345 acres.

BIXBY STORM CHANNEL – The channel runs parallel to the freeway and conflues with the Montecito Storm Channel. At the confluence, this channel is a trapezoidal concrete-lined channel, as shown on Sheet D-30.

The 100-year estimated peak discharge is calculated to be 203 cfs upstream of the confluence per “Hydrology Report No C01-S04,” dated July 2002 by Orange County Public Facilities and

Resources Department. The existing channel is a trapezoidal concrete channel with a bottom width of 3', height varies from 3.62' to 4.57', and slope of 1:1.

The Bixby Channel will be impacted by the WCCP. Construction for this project is set to begin in late 2010. The proposed freeway widening would redirect approximately 15.8 acres of drainage area to the existing Bixby Channel. Approximately 18 cfs would be added to the Bixby Channel. Due to the governing hydraulic condition at the Montecito Channel confluence, this additional flow would cause severe back-water flooding near the surrounding areas of the confluence. In addition, the Bixby Channel would not meet the OCFCD minimum freeboard requirement.

To mitigate the additional flow and freeboard issues, the WCCP Phase II project consultant, AECOM, proposed to improve Bixby Channel with a wider rectangular channel and analyze a bypass system that would discharge to the Montecito Channel downstream of its current confluence. This design would handle the freeway's surcharge flow and provide relief to Montecito Channel's already limited capacity and head restrictions.

The *Bixby Channel Diversion Drainage Report* (August 2009) and *Project Memorandum Supplemental Hydraulic Analysis and Supporting Calculations, Montecito and Bixby Channels Ultimate Improvement Condition* (August 2009) were prepared to support the proposed channel improvement and bypass improvements. The Bixby "bypass" channel would begin approximately 240 ft upstream of the existing confluence with the Montecito Channel. A triple 72-inch reinforced concrete pipe (RCP) is proposed to cross under I-405. The alignment of the "bypass" channel would parallel that of the existing Montecito Channel alignment and then confluence with the Montecito Channel approximately 1,080 ft downstream.

The Montecito Channel would also be widened. Approximately 1,050 ft of the Montecito Channel, beginning from 157 ft upstream of the Los Alamitos Channel confluence to the new Bixby "bypass" confluence, would need to be improved to achieve a lower downstream water surface control.

Bixby Channel will be improved from Old Ranch Parkway to the Montecito confluence. A new rectangular channel with a base width of 12' and heights between 4.6' to 6.5' will be

constructed as part of the WCCP. Because the I-405 widening would subsequently follow the WCCP, construction of the above bypass channel and widening of the Montecito Channel has been deferred until this project by OCTA. The interim and ultimate condition and regional improvements are discussed in the AECOM report mentioned above. The design phase for the I-405 improvement should include these improvements.

MONTECITO STORM CHANNEL – The size of the existing crossing facility is a double 8-ft by 8-ft reinforced concrete box (RCB) that flows from east to west. It confluences with the Bixby Storm Channel in the vicinity of the I-405/SR 22 interchange, as shown on sheet D-30.

The Montecito Storm Channel connects to the Los Alamitos Channel downstream of I-405. The Los Alamitos Channel ultimately drains to the Los Alamitos Retarding Basin where flows are metered out.

The 100-year estimated peak discharge for the Montecito Storm Channel is calculated to be 230 cubic feet per second (cfs) upstream of the confluence with the Bixby Channel, and 410 cfs downstream of the confluence with the Bixby Channel, per “Hydrology Report No C01-3.”

The Montecito Channel, along with the Bixby Channel, is proposed to be improved to accommodate the additional flows generated from the West County Connector Project, Phase 2 (I-405/I-605 HOV Connector Project) (WCCP) and this project. Proposed improvements are discussed below.

3.0 FLOODPLAIN EVALUATION

In accordance with FEMA FIRMs, the following water bodies have been designated flood hazard areas. A composite floodplain map and FEMA maps are located in Appendix B and display areas within the project limits that may have impacts to some of the higher flood hazard Zones A and AE. Hydraulic modeling evaluating the effects of the proposed improvement areas (along with potential flood mitigation where necessary) will be required to minimize impacts on existing flood levels. In general, a floodplain cannot be altered in any way until it has been shown such that alteration will pass the base flood without significant damage to either the floodplain or surrounding areas. No bridge abutment or embankment shall encroach on a regulatory floodway.

Proposed improvements that will encroach on the flood hazard areas will require additional studies for environmental permits; Section 404 and 401 Permits for USACE may be necessary. A location hydraulic study and summary Floodplain Encroachment Report will also be required.

The Federal Emergency Management Agency (FEMA) designates Special Flood Hazard Areas (SFHAs) according to Zones. The Base Flood Elevation (BFE) is the water-surface elevation of the 1% annual chance of flood. The zones are described as:

Zone A – Corresponds to the 100-year floodplains that are determined in the Flood Insurance Study (FIS) by approximate methods. No BFEs or depths have been determined.

Zone AE – Corresponds to the areas of 100-year floodplains that are determined in the FIS by detailed methods. In most instances, BFEs have been derived from detailed hydraulic analyses and are shown within this zone.

Zone AH – Corresponds to the areas of 100-year shallow flooding with a constant water-surface elevation. Flood depths of 1 to 3 feet (usually areas of ponding); BFEs are derived from detailed hydraulic analyses and are shown at selected intervals within this zone.

Zone AO – Corresponds to the areas of 100-year shallow flooding. Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

Zone AR – Depicts areas protected from flood hazards by flood control structures such as levees that are being restored.

Zone D – Depicts undetermined areas but possible flood hazards.

Zone X (dotted) – Other flood areas. Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

Zone X – Areas determined to be outside the 0.2% annual chance floodplain.

The following are descriptions for the Flood Hazard Areas along the project corridor:

1. Delhi Storm Drain

The Delhi Storm Drain, also known as the Santa Ana Garden Channel, is shown on FIRM Map #06059C0267J and #06059C0259, December 3, 2009. The channel is designated as Zone A, and 100-year flood discharge is contained in the channel.

The I-405 Improvement Project would not impact the Delhi Storm Drain floodplain.

2. Greenville-Banning Channel D03

The Greenville-Banning Channel is shown on FIRM Map #06059C0258J, December 3, 2009. The channel is designated as Zone A, and 100-year flood discharge is contained in the channel.

Alternatives 1 and 2 would not impact the Greenville-Banning Channel. Alternative 3 would require extension of the existing triple 12-foot by 12-foot reinforced concrete box (RCB) crossing at the upstream end to accommodate the proposed widen roadway. Work would also include reconstruction of headwall and wingwall, and channel work.

According to the preliminary hydraulics analysis (Preliminary Bridge Hydraulics Report for Greenville-Banning Channel, Parsons, January 2011), the proposed action would have a negligible amount of increase in water surface elevation and velocity. The culvert extension would not alter the existing floodplain.

3. Gisler Storm Channel

The Gisler Storm Channel is shown on FIRM Maps #06059C0258J and #C06059C0259J, December 3, 2009. The channel is designated Zone A, and 100-year flood discharge is contained in the channel.

Alternatives 1 and 2 would not impact the Gisler Storm Channel. Alternative 3 would have some roadway improvements that may impact the channel; however, the channel would be restored to its original state.

4. Santa Ana River

The SAR is shown on FIRM Map #06059C0258J, December 3, 2009. The SAR is designated as Zone A, and 100-year flood discharge is contained in the channel. The map also shows levee systems on both sides of the channel.

The adjacent lands are designated as Zone X (dotted). See FIRM maps regarding notes on levee system.

All of the build alternatives would have the same impact on the SAR. The proposed improvement is to widen the existing I-405 bridge over the river and add a new Euclid Street SB on-ramp bridge. Proposed improvements are shown in Appendix B.

According to the preliminary hydraulics analysis (Preliminary Bridge Hydraulics Report for Santa Ana River, Parsons, January 2011), the proposed improvements would cause a slight increase in water surface and velocities; however, normal depths would be reached shortly downstream on the proposed Euclid Street on-ramp bridge.

The 100-year floodplain would still be contained in the channel.

5. Fountain Valley Channel (D06)

The Fountain Valley Channel is shown on FIRM Map #06059C0254J, December 3, 2009. The channel is levied immediately upstream of I-405 and downstream, outside of Caltrans ROW. The channel is designated Zone A.

6. Ocean View Channel (C06)

The Ocean View Channel is shown on FIRM Maps #06059C0253J and #06059C0254J, December 3, 2009. The channel and adjacent lands are designated as Zone A north of I-405. The floodplain comingles with the East Garden Grove-Wintersburg Channel (EGGWC). The 100-year flows are contained in the channel downstream of the I-405.

7. East Garden Grove-Wintersburg Channel (C05)

The EGGWC is shown on FIRM Map #06059C0251J, December 3, 2009. The channel is levied downstream and upstream of I-405. The channel is designated as Zone A north and south of I-405, and it covers a considerably large area, including the Edinger Channel, Newland Channel, and Ocean View Channel. Residential areas are shown to be inundated by the 100-year storm.

According to the hydrology report for the EGGWC (Facility No. C05) Bolsa Chica Bay to Vermont Avenue, dated July 1990 by Environmental Management Agency, nearly the entire length of the EGGWC is deficient.

The I-405 Improvement Project proposes to widen the roadway over the channel. Bridges over the channel are proposed to minimize impacts to the channel. At the upstream end, it is proposed to construct a center pier hidden behind a retaining wall structure so that no bridge components would encroach on the channel. At the downstream end, it is proposed to construct a pier wall in line with the existing RCB walls.

OCFCD is currently studying the EGGWC at a regional scale. Several proposed structures, such as retention basins and channel widenings, are being considered to protect the area from potential flooding. Because the EGGWC system is very complex at the I-405 crossing, a physical model was constructed to depict actual field conditions. The physical model was completed in September 2010. OCFCD will use this information to develop a hydraulic model for EGGWC and its tributaries. Coordination with OCFCD for future phases of design shall be maintained to analyze the addition of piers.

8. Newland Storm Channel

The Newland Storm Channel is shown on FIRM Map #06059C0251J, December 3, 2009. The channel is designated as Zone A adjacent to I-405. According to OCFCD, the Newland Storm Channel is deficient. OCFCD is currently studying the channel and has plans for future improvements.

The I-405 Improvement Project would not impact the Newland Storm Channel.

9. Edinger Storm Channel (C05S05)

The Edinger Storm Channel is shown on FIRM Map #06059C0251J, December 3, 2009. The channel is designated as Zone A adjacent to I-405. The Edinger Storm Channel is currently in construction and will provide a 100-year level of protection. A new rectangular channel parallel to I-405 will be built, along with a new reinforced concrete pipe (RCP) under the freeway. Refer to the Edinger Improvement Plans, OCFCD 2009.

The I-405 Improvement Project would not impact the Edinger Storm Channel floodplain.

10. Westminster Channel (C04)

The Westminster Channel is shown on FIRM Map #060J9C0232J, December 3, 2009. The channel is designated as Zone A with some overtopping. The adjacent lands are designated as Zone X (dotted).

The I-405 Improvement Project would not impact the Westminster Channel floodplain.

11. Anaheim-Barber City Channel (C03)

The Anaheim-Barber City Channel is shown on FIRM Map #06059C0119J, December 3, 2009. The channel is designated as Zone A, and the 100-year flood discharge is contained in the channel.

The I-405 Improvement Project would not impact the Anaheim-Barber City Channel

12. Bolsa Chica Channel (C02)

The Bolsa Chica Channel is shown on FIRM Map #06059C0118J, December 3, 2009. The channel is designated as Zone A, and 100-year flows are contained in the channel. There is a

gap downstream of I-405 that is designated Zone D. East of the channel, the area adjacent to I-405 is designated as Zone X (dotted).

The I-405 Improvement Project would not impact the floodplain for the Bolsa Chica Channel.

13. Federal Storm Channel

The Federal Storm Channel is shown on FIRM Map #06059C0114J, December 3, 2009. The earthen channel downstream is designated as Zone D. The Old Ranch Golf Course Retarding Basin to the north is designated as Zone AE and outlets to the Federal Storm Channel. Flows from the retarding basin are metered out by a culvert under the freeway and outlets into an open earthen channel.

The I-405 Improvement Project would not impact the Federal Storm Channel floodplain.

14. Bixby Storm Channel (OCFCD Facility No. C01P04)

The Bixby Storm Channel is shown on FIRM Map #06059C0114J, December 3, 2009. The channel is designated as Zone A. The map shows that the 100-year flood discharge is contained in the trapezoidal concrete channel. The adjacent lands are designated as Zone X (dotted), protected by levees from 1 percent annual chance flood. Although there are no BFEs shown on the FEMA map, a recent hydrology study, Bixby Channel Diversion Drainage Study for the WCC Project (AECOM, August 2009), indicates that the 100-year flows overtop the existing channel. No floodplain delineations were modeled.

The WCC Project proposes to widen Bixby Channel because it will redirect approximately 15.8 acres to the Bixby Channel watershed. The existing trapezoidal channel will be reconstructed as a rectangular channel. The post-project condition 100-year discharge will still overtop the channel because the outlet at the Montecito Storm Channel controls the hydraulic system. In an agreement with OCFCD and OCTA, a new bypass channel for Bixby Channel would be constructed as part of the I-405 Improvement Project that would capture the 100-year discharge and alleviate additional flow on the Montecito Storm Channel.

15. Montecito Storm Channel (OCFCD Facility No. C01S03)

The Montecito Storm Channel is shown on FIRM Map #06059C0114J, December 3, 2009. The channel is designated as Zone A. The map indicates that the 100-year flood discharge is contained in the channel.

4.0 HYDRAULIC ANALYSIS

4.1 Design Criteria

Final design hydraulic analysis shall be performed in accordance with the Caltrans Highway Design Manual and OCFCD.

The design standards are summarized as follows:

- All offsite systems and other conveyance elements shall be investigated in accordance with acceptable hydraulic performance criteria including, but not limited to, Manning's equation for open channel and full flows. The Water Surface Pressure Gradient (WSPG) program is utilized for hydraulics of the pipes and channels.
- Investigations of offsite culverts should be performed for conduit hydraulic capacity along with verification of the inlet capacity calculations.
- Manning's equation for shallow, triangular, and rectangular channels shall be used to calculate the depth of flow and the design spread (T) of gutter flows where applicable, and it will be investigated in the PS&E phase of the project.
- The design spread width for the freeway shall follow Caltrans design criteria. The allowable design spread (T) is the flooded shoulder area up to the dike height or out to the edge of traveled way, which is 10 ft per Highway Design Manual Table 302.1 'Standards for Paved Shoulder Widths.' Calculations shall be provided at the PS&E phase of the project.
- Table 2-3 lists the hydrology summary for major offsite facilities.

5.0 PROPOSED DRAINAGE SYSTEMS

Proposed drainage systems shall be designed in accordance with the Caltrans Highway Design Manual and provisions from OCFCD, USACE, FEMA, and local cities. Offsite hydrology and hydraulic criteria shall be based upon OCFCD policies and procedures.

5.1 Offsite

For the most part, these flood control facilities will require lengthening of cross culverts at numerous locations, along with bridge widening at major tributaries. Coordination with OCFCD and Caltrans is critical because these washes carry a significant amount of flow. Existing studies, as well as any future studies, will have to be examined to ensure that peak flows are being conveyed. Coordination is also necessary with USACE for the SAR.

There are areas where embankments will have to be regraded to accommodate the roadway widening. Channels, transitions structures, slope stabilizers, headwalls, and wing walls will require reconstruction. Hydraulic studies for the channels and culvert analysis will be necessary to ensure that freeboard, headwater, and tailwater requirements are met.

Construction within any unlined streambed should be kept to a minimum to reduce environmental impacts, and any widening or lining must be approved by USACE (for the SAR) and OCFCD prior to construction. In addition, with medians being paved and the freeway widened, widening of overcrossings need special attention due to retrofitting of existing median drainage deck systems.

Table 5-1 summarizes the proposed improvements for offsite facilities.

TABLE 5-1
Proposed Offsite Improvements

Channel Name	Approximate Station	Type of Existing Facility	Proposed Improvements
Delhi Storm Drain	Sta 496+00	Triple 15'x15' RCB	Protect in Place
Gisler Storm Drain	Sta 594+10	Varies - 72" RCP, 84" RCP, 10'x10' RCB, 16'x10' RCB, and unknown channel geometry	Protect in Place
Mesa Verde Storm Drain	Sta 606+75	8' X 5' RCB	Protect in Place
Greenville-Banning Channel (D03)	Sta 623+88	Triple 12'x12' RCB	Extend RCP; inlet and outlet headwalls and RSP downstream will be modified.
Hyland Storm Drain	Sta 628+59	6'x6" RCB	Inlet headwall will be modified.
Santa Ana River	Sta 657+50	Rectangular concrete-lined with vertical side walls and a central low-flow channel W=240', H=23'	Bridge Widening, Pier Wall Extension, New In-River Columns for New On-Ramp
Fountain Valley Channel (D06)	Sta 681+74	Double 10'x7' RCB	Lengthen Culvert, Modify Inlet and outlet headwalls
Ocean View Channel (C06)	Sta 792+00	Double 12'x9.5' RCB	Lengthen Culvert Upstream
Heil Avenue Storm Drain	Sta 819+20	Triple 5' X 2' RCB	Lengthen Culvert Upstream and Downstream
East Garden Grove Wintersburg Channel (C05)	Sta 840+00	Triple 10'X 10' RCB 77" X 121" Elliptical RCP	RCB Extension Upstream. Structure Modification Downstream

TABLE 5-1
Proposed Offsite Improvements

Channel Name	Approximate Station	Type of Existing Facility	Proposed Improvements
Newland Channel	Sta 840+00	77" X 121" Elliptical RCP	Protect in Place
Edinger Storm Drain (C05S05)	Sta 841+75	Concrete Mod Trapezoidal Channel B=4', H=7' Z=1 63" RCP under I-405	Protect in Place. Coordinate Proposed Improvement by OCFCD. See 5.1.1 for further details.
Westminster Channel (C04)	Sta 944+00	Double 12' X 9.25' RCB	Protect in Place
Anaheim-Barber Channel (C03)	Sta 1027+83	Quad 10' X 9' RCB	Protect in Place
Milan Storm Drain	Sta 1066+00 Sta 1084+60	4' X 4' RCB Concrete Trapezoidal Channel, B=2', H=varies, Z=1.5'	Extend RCB at Sta 1084+00. Realign Channel Sta. 1084+00 to Sta. 1066+00
Bolsa Chica Channel (C02)	Sta 1099+00	Triple 12'x10' RCB	Protect in Place
Federal Storm Channel	Sta 1173+50	Double 8'x5' RCB	Protect in Place
Bixby Storm Channel*	Sta 1221+00	Concrete Trapezoidal Channel, B=3', H=3.62' to 4.57', Z=1 WCC Project Improve to Rectangular Channel B = 12', H = 4.6' to 6.5'	Construct Bixby Bypass Structure Per WCC Drainage Report
Montecito Storm Channel	Sta 1244+50	Double 8'x8' RCB	Extend RCB. Modify headwall and confluence structure

5.1.1 Other Flood Control Projects

OCFCD is in the process of completing the final design to improve the Edinger Storm Channel to provide additional hydraulic capacity. The project proposes to:

- Install a 72-inch by 113-ft elliptical RCP under I-405.
- Replace approximately 1,240 ft of the existing channel between I-405 and Edinger Avenue with a 20-ft-wide by 11-ft to 13-ft-deep open reinforced concrete rectangular channel.
- Replace the existing 63-inch RCP underneath Edinger Avenue with two 9-ft by 9-ft RCBs.
- Replace approximately 1,505 ft of the existing channel upstream of Edinger Avenue with a 20-ft-wide by 7.5-ft to 8.5-ft-deep open reinforced concrete rectangular channel.

Coordination with OCFCD has been initiated. The proposed RCP under I-405 is being designed to accommodate construction of the I-405 freeway widening. The proposed RCP under Edinger Avenue is also being designed to accommodate the Edinger Avenue overcrossing replacement. The proposed open rectangular channel north and south of Edinger Avenue would be constructed within the OCFCD ROW, with the north wall of the channel located directly adjacent to the State ROW.

5.2 Onsite

The roadway widening and median paving will increase onsite runoff. It is anticipated that existing inlets will have to be upgraded to accommodate higher discharges. Prior to final design, a visual inspection shall be conducted for all cross culverts. The culverts shall be evaluated with respect to their structural integrity, effectiveness, siltation, corrosive effects for corrugated metal pipes (CMPs), and for RCPs and traffic loading. The engineer shall then coordinate with Caltrans if replacement is necessary. In addition, Caltrans has since reduced the minimum time of concentration from 10 minutes to 5 minutes; therefore, this will affect the size and number of required inlets. The roadway widening will also require relocation of existing inlets to the new edge of pavement. If feasible, storm drain laterals shall be protected in place to prevent unnecessary pavement cuts. Capping the existing inlets can be an alternative to complete removal and/or reconstruction. Visual inspection of these storm drain

systems shall be conducted to assess their effectiveness. It may also be necessary to retrofit onsite systems to convey flows to Permanent Best Management Practice (BMP) locations.

Attachment 1 – Drainage Plan (D1a -6a and D1-30) shows the preliminary research of existing drainage facilities. During the PS&E phase, detailed pavement hydrology and hydraulic analysis shall be completed to calculate flows and size the onsite drainage facilities.

5.3 Impacts on Existing Drainage Systems

Channels

There would be several culvert and bridge widening improvements required for this project, which may affect the existing channels. Most of the bridge work would require only minor channel modifications and would not affect their ability to convey flow. Culverts would have to be extended to the new toe of slope. Hydraulic modeling was developed for some larger channels to compare the existing and proposed conditions. For other channels, sound engineering judgment based upon similar type work was utilized to conclude minimal impact to the channel capacity, flow, and freeboard. During PS& E design phase, hydrology and hydraulic study shall be completed for these facilities.

Ditches

There are several roadside ditches parallel to the freeway that would require piping. Due to the proposed widening and ROW constraints, replacing the ditches with pipe conduits would be necessary. Typically these pipes would lie underneath the outside shoulders. During PS& E design phase, hydrology and hydraulic study shall be completed for these facilities.

6.0 WATER QUALITY OVERVIEW

6.1 Beneficial Uses of Local Water Resources

Flows from the proposed project site enter designed drainage facilities, and all runoff from within the project limits is eventually conveyed to Reaches 1 and 2 of the SAR. The SAR outlets to the Pacific Ocean between Newport Beach and Huntington Beach. The following receiving water bodies are tributary to the Santa Ana River, Aliso Creek, and Carbon Canyon Creek.

The Santa Ana Regional Water Quality Control Board (RWQCB) designates beneficial uses for waters in the SAR Watershed, which are identified in the Basin Plan (RWQCB 1995). The beneficial uses that have been identified for Reaches 1 and 2 of the SAR are as follows:

- Municipal and Domestic Supply – Waters are used for community, military, municipal, or individual water supply systems. These uses may include, but are not limited to, drinking water supply.
- Agricultural Supply – Includes uses for farming, ranching, or horticulture including, but not limited to, irrigation, stock watering, or support of vegetation for range grazing.
- Wildlife Habitat – Uses of water that supports terrestrial ecosystems including, but not limited to, preservation and enhancement of terrestrial habitats, vegetation, wildlife (e.g., mammals, birds, reptiles, amphibians, invertebrates), or wildlife water and food sources.
- Groundwater Recharge – Used for natural or artificial recharge of groundwater for purposes including future extraction and maintaining water quality.
- Rare, Threatened, or Endangered Species – Uses of water that support habitats necessary, at least in part, for the survival and successful maintenance of plant or animal species established under state or federal law as rare, threatened, or endangered.
- Warm Freshwater Habitat – Maintenance of warm water ecosystems.
- Body Contact Recreation – Recreational activities involving body contact with water.
- Non-Body Contact Recreation – Recreational activities involving proximity to water, but generally no body contact or ingestion of water.
- Spawning, Reproduction, and Development – Waters support high-quality aquatic habitats necessary for reproduction and early development of fish and wildlife.

6.2 Water Quality Impacts and Mitigation

The proposed project is anticipated to increase the volume of downstream flow because of the addition of impervious surface area. Currently, there are no known BMPs along the project corridor, except for the upcoming WCCP, which will construct several treatment BMPs.

For study purposes, Alternative 3 was analyzed to determine the extent of required BMPs. Alternative 3 will generate the most disturbed soil area and additional impervious area. Within the project limits, the total disturbed soil area is 432 acres, the existing paved surface area is estimated to be 468. Alternative 3 is expected to add approximately 105 acres of impervious surface. Operational impacts associated with the increase in impervious surface area would be mitigated by the incorporation of Caltrans approved Treatment BMPs. At this stage, 34 potential Treatment BMP locations have been identified and are shown in Attachment 2.

Although the applicability of all nine Caltrans-approved Treatment BMPs is being analyzed for this project, it is anticipated the Treatment BMPs that would be implemented are infiltration devices, biofiltration swales, media filters, and detention devices, or any combination thereof. At this stage, only biofiltration swales and infiltration basins are being considered. During PS&E other BMPs will be considered as additional data will become available. Additionally, with the implementation of various Design Pollution Prevention BMPs (e.g., providing benches or terraces on high cut and fill slopes, rounding slopes, flaring the ends of outlets, and incorporating headwalls, transition structures, and splash walls where necessary), water quality would not be substantially degraded. With implementation of the various Permanent BMPs, storm runoff quality will be improved at the receiving water body.

6.3 Evaluation of Best Management Practices

The Targeted Design Constituent (TDC) approach outlined in the Caltrans Project Planning and Design Guide (PPDG 2007) was used to determine the prioritization for the potential Treatment BMPs. A TDC is a pollutant that has been identified during Departmental runoff characterization studies to be discharging with a load or concentration that commonly exceeds allowable standards and which is considered treatable by currently available Caltrans approved Treatment BMPs. Within the project limits, none of the above-mentioned water

bodies are on the 303 (d) List of Water Quality Limited Segments; therefore, there are no TDCs identified for the proposed project. Although none of the direct receiving waters are on the 303 (d) List of Water Quality Limited Segments, it should be noted that pathogens are not a pollutant that are generated from roadway surfaces. Although there are no TDCs identified for the proposed project, the PPDG recommends considering the Treatment BMPs in the order listed below:

- Infiltration Devices
- Media Filters
- Biofiltration Strips
- Biofiltration Swales
- Austin Sand Filters
- Detention Devices
- Traction Sand Traps
- Multi Chambered Treatment Trains (MCTTs)
- Wet Basins

Tables 6-1 and 6-2 summarize proposed Treatment BMPs for the project. Calculations are based upon Caltrans Basin Sizer Program. Tributary area delineation and potential BMPs are shown in Attachment 2 – BMP Layout 1- 35.

Table 6-1 Proposed Infiltration Devices		
Infiltration Device (BMPs)	Tributary Area (Acres)	Water Quality Volume* (Acre-ft.)
1	7.1	0.46
4	3.4	0.22
7	4.9	0.31
8	8.2	0.53
11	2.8	0.18
14	7.7	0.49
16	2.7	0.17
18	6.3	0.40

**Table 6-1
Proposed Infiltration Devices**

Infiltration Device (BMPs)	Tributary Area (Acres)	Water Quality Volume* (Acre-ft.)
20	13.9	0.89
21	11.5	0.74
24	8.8	0.56
25	10.2	0.65
26	7.0	0.45
TOTAL=	94.5	6.06

**Table 6-2
Proposed Biofiltration Swales**

Biofiltration Swale (BMPs)	Tributary Area (Acres)	Water Quality Flow** (CFS)
2	4.3	0.87
3	1.4	0.28
5	1.3	0.26
6	1.4	0.28
9	5.5	1.11
10	10.0	2.02
12	2.5	0.50
13	2.5	0.50
15	7.4	1.49
17	4.9	0.99
19	4.7	0.95
22	2.1	0.42
23	2.5	0.50
27	1.9	0.38
28	2.1	0.42
29	2.2	0.44
30	1.0	0.20
31	3.7	0.75
32	1.5	0.30
33	4.0	0.81
34	2.6	0.52

Table 6-2
Proposed Biofiltration Swales

Biofiltration Swale (BMPs)	Tributary Area (Acres)	Water Quality Flow** (CFS)
TOTAL=	69.5	14.02

* Water Quality Volume (Acre-Ft) = Tributary Area (Acres) * Water Quality Depth (Feet)

** Water Quality Flow (Cubic Feet Per Second) = $C \cdot i \cdot \text{Tributary Area (Acres)}$

where: C = runoff coefficient (1)

I = rainfall intensity (0.2 in/hr) per Caltrans Basin Sizer program.

6.4 Temporary Construction BMPs

Construction Site BMPs will be evaluated through the preparation of the Storm Water Pollution Prevention Plan (SWPPP). The SWPPP shall address all state and federal water control requirements and regulations. The SWPPP shall address all construction-related activities, equipment, and materials that have the potential to impact water quality. The SWPPP shall include BMPs to control pollutants, sediment from erosion, stormwater runoff, and other construction-related impacts. In addition, the SWPPP shall include the provisions of State Water Resources Control Board (SWRCB) Resolution No. 2001-046, which requires implementation of specific Sampling Analysis Procedures (SAP) to ensure that the implemented BMPs are effective in preventing the exceedance of any water quality standards.

Construction activities shall conform to current federal, state, and local regulatory requirements to minimize impacts to water resources and water quality. This would be accomplished by conforming to the requirements of the Caltrans Statewide National Pollutant Discharge Elimination System (NPDES) Storm Water Permit, Order 2009-0009-DWQ. The construction general permit was adopted by the SWRCB on September 2, 2009; the order is effective July 1, 2010.

Because detailed Construction Site BMPs are not known at this time, a general list of Construction Site BMPs that are expected to be implemented for this project are as follows: SS-1 Scheduling, SS-2 Preservation of Existing Vegetation, SS-4 Hydroseeding, SS-5 Soil Binders, SS-7 Geotextiles, Plastic Covers, Erosion Control Blankets & Mats, SS-9 Earth

Dikes/Drainage Swales & Ditches, SS-10 Outlet Protection/Velocity Dissipation Devices, SC-1 Silt Fence, SC-5 Fiber Rolls, SC-6 Gravel Bag Berm, SC-7 Street Sweeping and Vacuuming, SC-8 Sandbag Barrier, SC-10 Storm Drain Inlet Protection, TC-1 Stabilized Construction Entrance/Exit, TC-3 Entrance/Outlet Tire Wash, NS-1 Water Conservation Practices, NS-2 Dewatering Operations, NS-3 Paving and Grinding Operations, NS-6 Illicit Connection/Illegal Discharge Detection and Reporting., NS-12 Concrete Curing, NS-15 Structure Demolition/Removal Over or Adjacent to Water, WM-1 Material Delivery and Storage, WM-2 Material Use, WM-3 Stockpile Management, WM-4 Spill Prevention and Control, WM-5 Solid Waste Management, WM-6 Hazardous Waste Management, WM-7 Contaminated Soil Management, WM-8 Concrete Waste Management, WM-9 Sanitary/Septic Waste Management, and WM-10 Liquid Waste Management.

7.0 SUMMARY

The I-405 Improvement Project would provide traffic relief to commuters by adding travel lanes. Impacts to existing local and regional drainage systems are of concern. The additional impervious areas and impacts to existing drainage facilities would have to be mitigated. Considerations include additional flow rates; increase in time of concentration; water quality; deficient systems; governing hydraulic conditions; City, OCFCD, and USACE future projects; and physical and ROW constraints.

At a regional level, the additional impervious area would not generate enough flows to impact major flood control facilities.

The total areas for each of the watersheds that the proposed project traverses are as follows:

- 1) SAR Watershed has an area of 2,800 square miles
- 2) Talbert Watershed has an area of 21.4 square miles
- 3) Westminster Watershed has an area of 78.1 square miles.
- 4) Los Alamitos Watershed has an area of 5.4 square miles

Because the total area of these watersheds is 2,905 square miles, the 103-acre increase in paved surface makes up only 0.006-percent of the area of the watersheds. This can be expected to translate into minor regional increase in runoff for flood control facilities.

According to the preliminary assessment of this report, onsite and local drainage improvements/retrofits are feasible and can accommodate the proposed freeway widening. Proposed offsite drainage improvements are also feasible, which will include lengthening of culverts and bridges and other related structural improvements.

The preliminary drainage concept for this project includes the following:

- 1) Maintain existing drainage pattern.
- 2) Median drainage to be collected in inlets instead of allowing to run along median barriers.
- 3) Relocate inlets to new edge of pavement.
- 4) Incorporate Treatment BMPs whenever possible.
- 5) Minimize disturbance to natural channels.

- 6) Consider bridge deck drains.
- 7) Consider hydroplaning by increasing cross slopes and adding more inlets.
- 8) Minimize in-channel work.
- 9) Analyze flood-hazard areas to ensure that the 100-year flood levels and limits are not altered.
- 10) Maintain existing access to offsite flood control facilities or provide new ones.

Considerations for PS&E Phase:

- 1) Detailed hydrology and hydraulic analysis for onsite systems.
- 2) Retrofit existing deficient onsite systems.
- 3) Coordinate with City, OCFCD, and USACE for offsite systems.
- 4) Design drainage according to the Caltrans Highway Design Manual and OCFCD Hydrology and Hydraulic Manual.
- 5) Design, Treatment, and Construction BMPs shall be considered.
- 6) Coordinate water quality with Santa Ana RWQCB.
- 7) Coordinate with the Caltrans Maintenance Unit for existing freeway flooding problems.

APPENDIX A
HYDROLOGIC AREAS AND FLOOD CONTROL
FACILITIES

